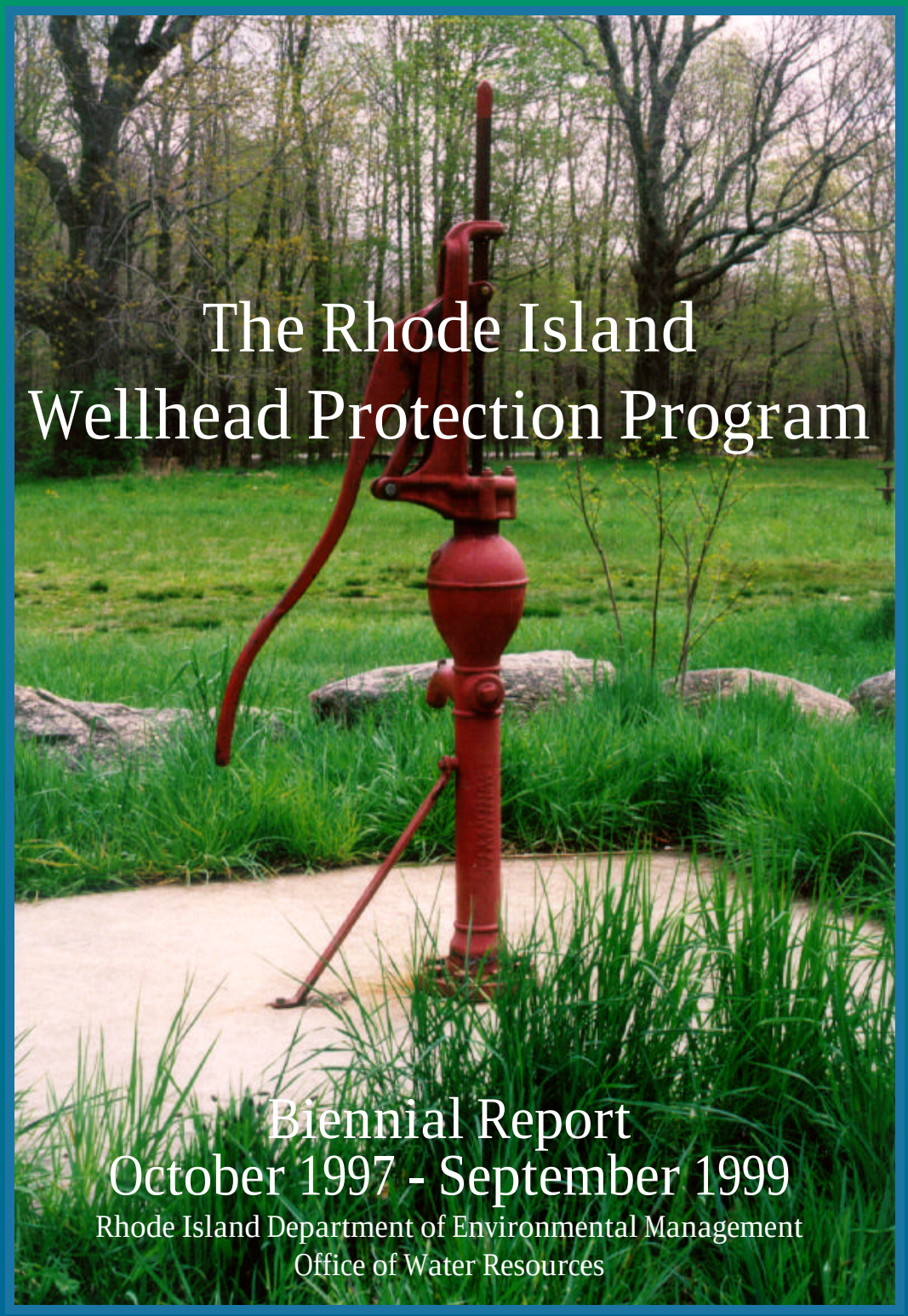

The Rhode Island Wellhead Protection Program

Biennial Report
October 1997 - September 1999

Rhode Island Department of Environmental Management
Office of Water Resources

Rhode Island Department of Environmental Management
Office of Water Resources

WELLHEAD PROTECTION PROGRAM
1999 BIENNIAL HIGHLIGHTS

As of June 1999, there were 671 public wells located in 31 communities in the Rhode Island Wellhead Protection (WHP) Program, an increase of 29 wells from the 1997 Biennial Report. The total acreage designated as wellhead protection areas in RI increased by 903 acres to 93,660 acres.

The emphasis of the RI WHP Program has been on the development and implementation of wellhead protection plans.

> Plans are developed at both the municipal and water supplier levels. During this reporting period, the percentage of community water supply systems that are addressed by a wellhead protection plan has increased from 6% in 1997 to 52% in 1999, and the percentage of non-community water supply systems addressed by a plan has increased from 4% in 1997 to 25% in 1999. These plans provide the framework for action by the municipality or supplier to protect its drinking water supply.
>
> DEM used $60,000 from an EPA grant in 1999 to fund implementation of municipal and water supplier WHP activities. Five communities and two suppliers were chosen to receive the grants, which ranged from $4,500 to $11,250. The projects funded included various public education efforts, wellhead protection area road signs, a teacher training program, underground storage tank removal, adoption of a groundwater protection ordinance, and secondary containment for a back-up generator.

The Rhode Island Department of Health developed the Source Water Assessment Program as required by the federal Safe Drinking Water Act during this reporting period. This is an ambitious program to identify potential sources of contamination in the wellhead protection areas and in watersheds to drinking water reservoirs, determine the water supply's susceptibility to contamination from those sources, and distribute the assessments to the public. The Department of Health has worked closely with DEM in coordinating this program with the WHP Program to make them complementary and to maximize the benefits of both to municipalities and suppliers.

Looking Ahead

WHP plan development and implementation will continue to be the focus of DEM's efforts. The Department is funding another round of grants available to municipalities and suppliers for implementing wellhead protection activities. DEM looks forward to the Department of Health Source Water Assessment Program generating interest in wellhead protection plans.

Protection of the state's groundwater resources will require continued efforts on behalf of the state and local governments, the water suppliers and the public, with success measured by our ability to sustain vital groundwater resources in a condition free of contamination.

Introduction

The Rhode Island Wellhead Protection Program is an important element in the state's effort to protect groundwater resources and maintain safe drinking water supplies. This program was developed by the Department of Environmental Management (DEM) in recognition of groundwater's importance. Presently, most of the state's groundwater is of good to excellent quality and continuing this status depends on establishing protection measures to assure the long-term viability of this resource.

Groundwater is extremely valuable to the state. **Two-thirds** of Rhode Island communities rely in whole or in significant part on groundwater resources for their drinking water supplies. Moreover, twelve communities derive **all** their drinking water from groundwater sources. With such dependence on this resource, it makes sense to prevent its contamination.

The nature of Rhode Island's ground-water resources renders them vulnerable to contamination. Conditions such as a high water table, unconfined permeable soils, and fractured bedrock may allow pollutants to be easily transported. This situation is reflected in the fact that the number of sites at which persistent groundwater contamination has been confirmed continues to grow. Chemical contamination of groundwater is further reflected in data from public wells that indicates approximately 15-20% of public wells tested for volatile organic compounds have reported a positive detection.

Besides the state's considerable dependence on groundwater for drinking water supplies and its vulnerability, preventing contamination saves the state and its water consumers money. Not only is there a lack of alternative water supplies in many areas, but treating water is expensive. Further, if groundwater resources become polluted, remediation is expensive, often lengthy, and sometimes, technically infeasible. Once again, taking steps to prevent contamination of groundwater is the best method to preserving drinking water quality. The goal of the Rhode Island Wellhead Protection Program is the protection of those groundwater resources contributing water to public wells in the state.

The Rhode Island Department of Environmental Management with assistance from other state and local agencies, developed the Wellhead Protection Program in 1990, which was subsequently approved by the US Environmental Protection Agency. This report satisfies the requirements of the Safe Drinking Water Act (SDWA) of 1986, Section 300h-7(g) which requires that each State with an approved Wellhead Protection Program "shall submit to the Administrator a biennial status report describing the state's progress in implementing the program."

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Program Overview

The Rhode Island Wellhead Protection Program was developed to prevent contamination of groundwater resources supplying public wells. It applies to **all public wells** in the state and focuses on the critical portion of the aquifer through which groundwater moves towards a public well, also known as a wellhead protection area (WHPA).

The three steps of the Rhode Island WHP Program are as follows:

1. DELINEATION of the WHPAs:

   Delineations were completed by DEM in 1993 and provided to each water system owner and municipality. DEM periodically updates the statewide WHPA map. (See map at end of this report.)

2. IDENTIFICATION of POLLUTION SOURCES:

   Inventories of known and potential sources of groundwater contamination within the WHPAs are completed by the towns and the large water suppliers. The procedure involves a field survey of the WHPA and a review of state records to collect information about the facilities located in the WHPA.

3. WELLHEAD PROTECTION:

   The large water suppliers and many local governments must develop a plan to protect groundwater within their WHPAs. Wellhead protection plans provide a framework for implementing and coordinating local protection strategies. Each community and large water supplier will determine the most suitable strategies given their own unique circumstances. At the state level, WHPAs are priority areas for protection in the implementation of DEM's regulatory programs. WHP requirements were first incorporated into the DEM Groundwater Quality Regulations in July 1993.

The program has made significant progress, reflecting the cooperative approach being taken by federal, state and local officials as well as water suppliers. The first two key steps of the WHP program are largely complete. As a result, attention now is being focused on the most meaningful part of the program—development and implementation of protection measures.

Public Wells in Rhode Island

There is often considerable confusion about the term "public well" because it includes many wells other than the major municipal water system wells. For example, a well owned by a private business such as a restaurant that serves the public is a "public well."

A public well is a well that supplies water to a "public water system." A public water system provides drinking water to fifteen or more service connections or, regularly serves an average of at least twenty-five individuals daily at least sixty days of the year. There are three categories

Department of Environmental Management and the Department of Health

The Rhode Island Department of Environmental Management (DEM) and the Rhode Island Department of Health (DOH) both play key roles in ensuring clean drinking water in Rhode Island.

DEM's role is to provide for protection of the groundwater resources of the state. DEM has established several sets of regulations for the control of specific sources of pollution and the remediation of groundwater once it becomes contaminated. The goal of DEM's WHP Program is protection of groundwater resources supplying public wells. Groundwater protection must not be limited to that groundwater supplying public wells. In many communities, the vast majority of the residents are dependent on their own private drinking water well. And because groundwater is moving towards and will one day enter a stream, lake or other surface water body, groundwater protection is vital to overall environmental protection. Ultimate protection of this groundwater resource depends on wise decision-making by local governments and individuals as well as the state in the administration of its regulatory programs.

The Department of Health is responsible for ensuring proper operation and maintenance of the public water systems in such a manner that the water supply remains safe. As part of this responsibility, DOH requires that all public water supply systems comply with specific water quality testing procedures and take action on their own property to minimize the threat of groundwater contamination. Also, DOH has responsibility for the Source Water Assessment Program (SWAP) required by the 1996 amendments to the federal Safe Drinking Water Act. This is an ambitious program to identify potential sources of contamination in the wellhead protection areas and in watersheds to drinking water reservoirs, determine the water supply's susceptibility to contamination from those sources, and distribute the assessment results to the public.

If you have questions regarding the water quality provided by your public system or the operation of this system, contact the Department of Health, Division of Drinking Water Quality at 222-6867. If you have concerns about groundwater protection, contact the DEM Office of Water Resources at 222-3961.

Table 1: Types of Public Wells

Community Well
-serves year-round residents
-at least 15 service connections or at least 25 residents
-examples include municipal wells, nursing home wells, condominiums, mobile home parks
-there are 70 groundwater dependent community water systems using 168 wells

Non-Transient, Non-Community Well
-regularly serves at least 25 of the same persons (not residents) over 6 months of a year
-examples include schools and places of employment
-there are 76 groundwater dependent non-transient, non-community water systems using 100 wells

Transient Non-Community Well
-does not regularly serve the same persons
-does serve at least 25 people at least 60 days of the year
-examples include restaurants and hotels
-there are 342 groundwater dependent transient non-community systems using 403 wells

Source: Rhode Island Department of Health (June 1999)

of public water systems, as described in Table 1. All public water systems in the state are regulated by the Rhode Island Department of Health (DOH) to ensure that the water consumed by the public meets drinking water standards.

Using DOH records from June 1999, there were 671 wells located in thirty-one communities in the WHP program. There was a net increase of 29 in the number of public wells from June 1997. The total number of public wells and water systems served are shown in Table 2. The total acreage designated as WHPAs in RI increased by 903 acres to 93,660 (Appendix 2).

The emphasis in the WHP Program is on those wells that serve year-round resident populations, referred to as **community water supply wells**. There are 168 community wells located in twenty-seven municipalities. These community wellhead protection areas are a priority for DEM pollution source control programs and ground-water remediation efforts. DEM is also encouraging municipalities to consider these areas a priority requiring special consideration in their local WHP planning.

Table 2: Rhode Island Public Water Supply (PWS) Systems and Wells

Type of System/Well	Number of Systems	Number of Wells
PWS Systems (Ground/Surface water)	504	—
PWS Systems Utilizing Groundwater [1]	488	671
Community Water Supply Systems (Ground/Surface water)	85	—
Community Water Supply Systems Utilizing Groundwater [1]	70	168
Non-Transient, Non-Community PWS Systems Utilizing Groundwater	76	100
Transient, Non-Community PWS Systems Utilizing Groundwater	342	403

[1] Includes five systems that purchase water from other systems utilizing groundwater and includes 7 community systems that use both groundwater and surface water. There are no non-community systems that use both groundwater and surface water.

Source Water Assessment Program

The Source Water Assessment Program (SWAP) was established by the 1996 amendments to the Safe Drinking Water Act. The purpose of the Program is to assess the threats to sources of public drinking water and determine the water supply's susceptibility to these threats. The RI Department of Health, Office of Drinking Water Quality is responsible for the development and implementation of this Program. The Department of Health has worked closely with DEM in coordinating the Source Water Assessment Program with the Wellhead Protection Program to make them complementary and to maximize the benefits of both to suppliers and municipalities.

There are four basic requirements of the SWAP:

1) Delineate the area that contributes water to the source, referred to as the source water protection area. For wells, this is the DEM wellhead protection area;

2) Inventory the source water protection area for potential sources of contamination;

3) Assess the overall susceptibility of the water supply to contamination and estimate the risk associated with each potential source of contamination; and

4) Make the results of the assessments known to the suppliers and consumers of the water supply.

The Department of Health will produce the assessments and provide them to the suppliers and general public. A final draft of the Plan has been submitted to EPA for approval. All assessments must be completed by May 2003.

Large Public Water Suppliers Utilizing Groundwater

The large public water suppliers in the state have been subject to several water supply/protection plan requirements (Appendix 1). Over the past few years these suppliers have been required to submit "Water Quality Protection Plans" to the RI Water Resources Board, "Water Supply Management Plans" to one Division of DEM and "Wellhead Protection Plans" to another Division of DEM. As explained in Appendix 1, recent and pending changes to state laws and regulations have consolidated these requirements into **one** "Water Supply System Management Plan" to be submitted to the RI Water Resources Board. DEM will have an opportunity to review the plan for consistency with the WHP Program.

Large public water suppliers are water suppliers and institutional water suppliers which obtain, transport, purchase, or sell more than 50,000,000 gallons of water per year. The 15 large public water suppliers utilizing groundwater that have been subject to the requirements above are listed in Table 3.

These large water suppliers currently operate 62 wells, the majority of which were installed over 25 years ago. Two-thirds of the wells have pumping capacities of 500 gallons per minute or more. With the exception of the wells in Jamestown, all of these wells are located in stratified drift deposits of sand and gravel. The typical hydrogeologic setting for these wells is shown in Figure 2.

WHP Program Accomplishments

The following is a detailed discussion of the accomplishments made under each of the three WHP Program elements. EPA has determined that it is best on a national level to track program implementation by

Figure 1: Wellhead Protection Key Steps

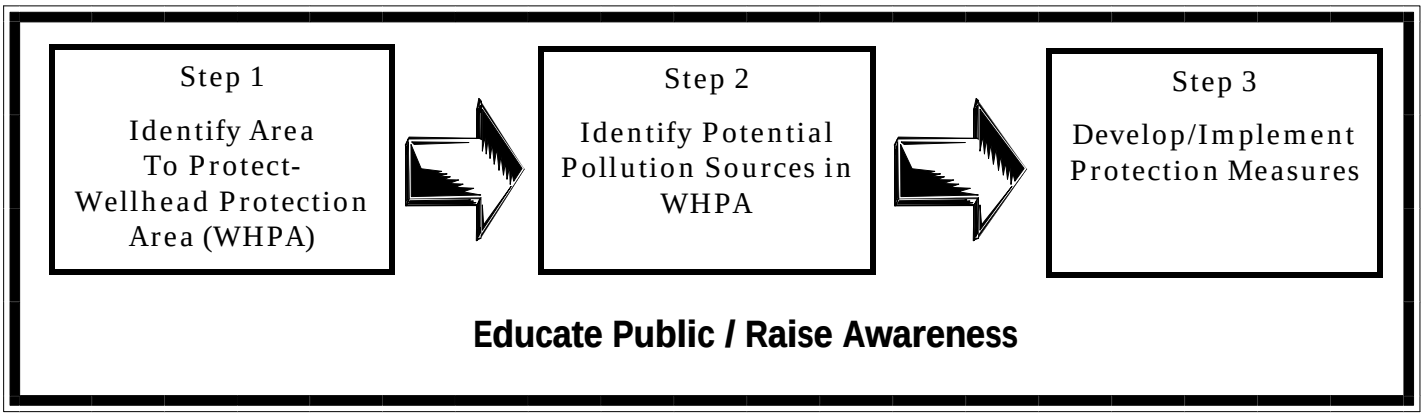
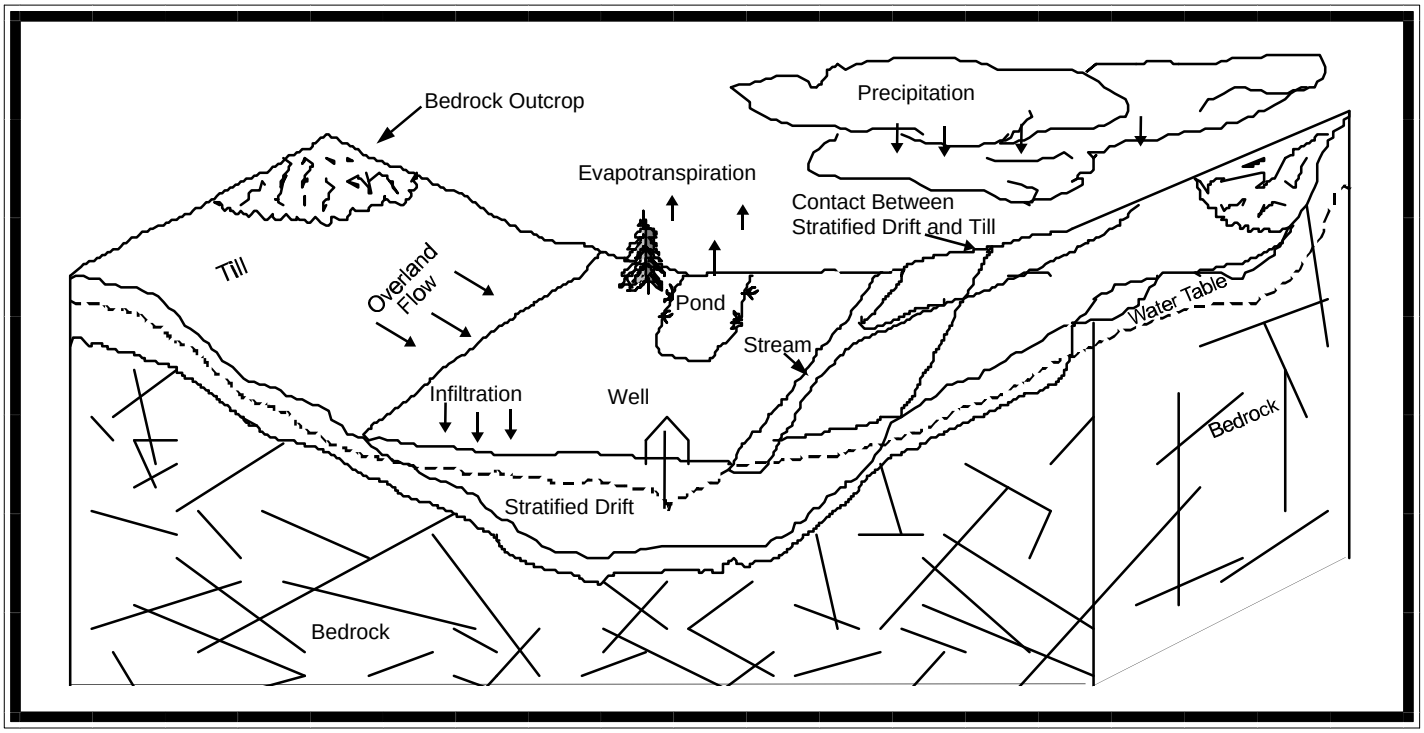


Figure 2: Cross-section of a Stratified Drift Aquifer



Source: Trench, E.C.T. and Morrissey, D.J. 1985. Recharge Area Report 1, U.S. Geological Survey.

individual water supply system. However, the RI WHP Program places the primary program responsibility on the municipalities and the 15 large water supply systems. Therefore, when reporting progress below, DEM has reported progress by individual systems as requested by EPA and also by municipalities and large water suppliers. In reporting progress, EPA has allowed the state to indicate where significant partial progress has occurred.

STEP 1

Delineation of Wellhead Protection Areas

Rhode Island was the first state in the nation to complete delineation of all its wellhead protection areas. Mapped by DEM hydrogeologists, these initial delineations were provided to each large water supplier and each municipality in 1993. The delineations are based on reasonably available information regarding the hydrogeologic environment and the well characteristics. (See Table 4 for status of Step 1.)

The WHPAs are delineated using the US Geological Survey quadrangle maps (1:24,000). WHPA maps are available for review at the DEM Office of Water Resources and through the DEM web page at **www.state.ri.us/dem**. DEM utilizes the RI Geographic Information System (RIGIS) extensively in the delineation of the WHPAs and in preparation of maps

Table 4: Step 1 Status— Delineation of Wellhead Protection Areas

System Size (population)	Number of Community PWS Systems Completed	Total Population Served
Over 50,000	2	173,706
10,000-50,000	7	164,520
3,300-10,000	5	23,818
1,000-3,300	3	6,284
25-1,000	48	6,571
TOTAL	**65**	**374,899**
Non-Transient non-community PWS systems completed: 76 Transient non-community PWS systems completed: 342		

Table 3: Large Public Water Systems Which Utilize Groundwater

System Name	Municipalities Served	Location of Well(s)	Location of WHPA(s)	% System Dependence on Groundwater [1]	Population Served by Groundwater [2]
Bristol Co. Water Authority	Barrington Bristol Warren	Barrington	Barrington	17%	7,990
Cumberland	Cumberland	Cumberland	Cumberland	17%	3,430
Harrisville Fire District	Burrillville	Burrillville	Burrillville	100%	3,470
Jamestown	Jamestown	Jamestown	Jamestown	15%	458
Kent County Water Authority	Coventry East Greenwich Warwick West Greenwich West Warwick	Coventry Warwick	Coventry East Greenwich North Kingstown Warwick West Greenwich	20%	12,741
Kingston Water District	South Kingstown	South Kingstown	South Kingtown	100%	3,400
Lincoln Water Commission [3]	Lincoln	Lincoln	Lincoln	0%	0
North Kingstown	Narragansett North Kingstown	East Greenwich North Kingstown Warwick	East Greenwich Exeter North Kingstown Warwick West Greenwich	100%	24,000
Pascoag Fire District	Burrillville	Burrillville	Burrillville	100%	3,500
Pawtucket Water Supply Board	Central Falls Cumberland Pawtucket	Cumberland	Attleboro, MA Cumberland North Attleboro, MA	5%	5,400
RI Economic Development Corporation	North Kingstown	East Greenwich Warwick	East Greenwich North Kingstown Warwick	100%	9,200
South Kingstown	South Kingstown	South Kingstown	South Kingstown	100%	3,448
United Water Company	Narragansett South Kingstown	South Kingstown	South Kingstown	100%	17,500
University of Rhode Island [4]	South Kingstown	South Kingstown	South Kingstown	100%	14,000
Westerly	Stonington, CT Westerly	Stonington, CT Westerly	N. Stonington, CT Stonington, CT Westerly	100%	38,000

[1] Percent system dependence on groundwater provided by the suppliers.

[2] For those systems with less than 100% dependence on groundwater, the population served by groundwater is estimated by total population served by the system multiplied by % dependence on groundwater. Total population served provided by the RI Department of Health.

[3] Lincoln Water Commission wells are on standby status. Currently, Lincoln purchases all of its water from the Providence Water Supply Board.

[4] The University of Rhode Island was designated a large water supplier under the RI Water Resource Board “Rules and Procedures for Water Supply System Management Planning” (October 1998).

for local governments and water suppliers. The WHPAs cover approximately 14% of the state, or 93,660 acres. The largest WHPAs cover approximately 2,000 acres and the smallest ones approximately fifteen acres. The acreage designated for community wells is 37,018 or about 5% of the state's land area. The number of WHPAs varies regionally with the dependence on groundwater.

Charlestown, which has the largest number of public wells (87) of any community, also has the largest percentage of town land area designated as WHPAs (38%). Other communities with significant percentages of land area designated as WHPAs include New Shoreham (35%), North Smithfield (35%), Glocester (25%), Hopkinton (21%), Westerly (19%), and Richmond (19%). Refer to Appendix 2 for specific WHPA data on all towns. WHPAs for several wells in Rhode Island extend across state boundaries into Connecticut and Massachusetts, resulting in 1,912 acres designated as a WHPA out of state.

Delineation Methods

For the community systems and the larger non-community systems (greater than ten gallons per minute), the WHPAs were delineated using a mathematical model in conjunction with mapping based on the hydrogeologic characteristics in the area. The approach differed depending on if the well was withdrawing water from bedrock or stratified drift. The maximum extent of the WHPAs in the upgradient direction of groundwater flow for most of the larger wells is between one-half mile and two miles.
For wells in stratified drift, the uniform flow equation was solved using the MWCAP module of the Environmental Protection Agency WHPA model software to generate a curve showing that portion of the stratified drift which contributes water to the well. In a typical mapping scenario, the curve was extended to the boundary between the stratified drift and till deposits. At this point, topographic contours were used in lieu of water table information to determine groundwater that flows into the curve. (See Figure 3.)

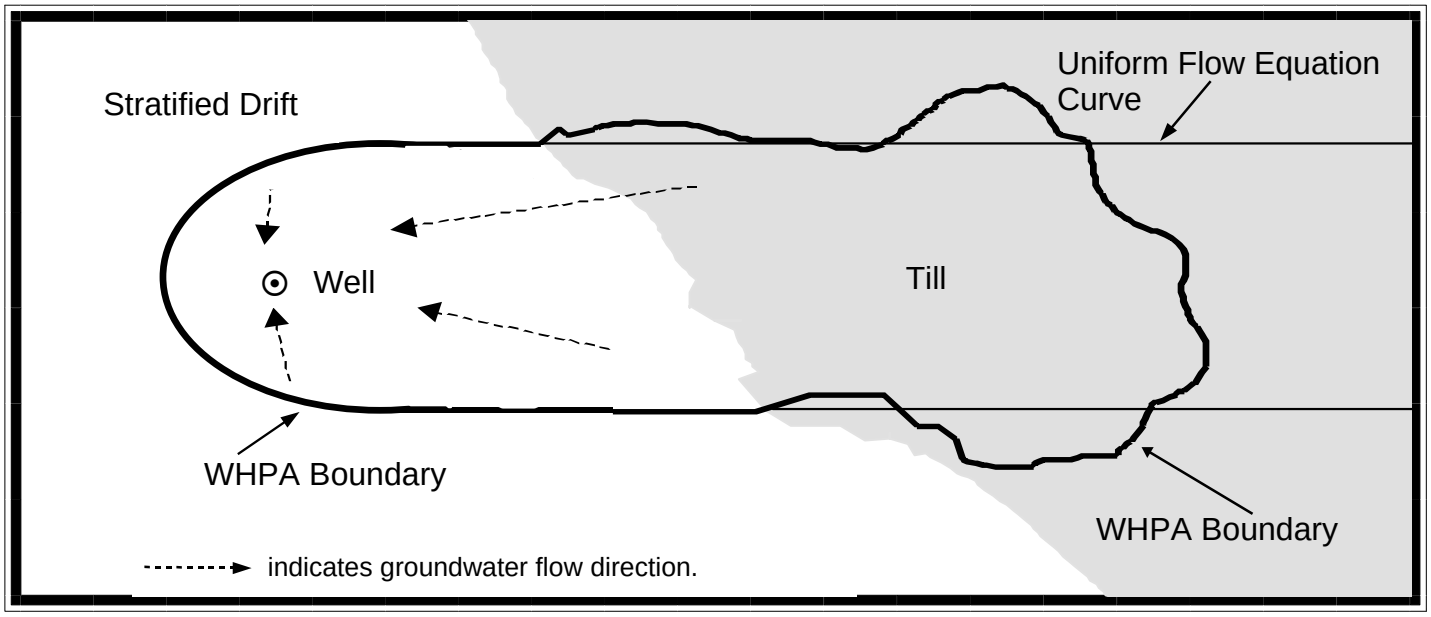
Because of the difficulty in determining groundwater flow direction in bedrock, WHPAs for the larger bedrock wells were delineated using a circle generated by application of the Theis equation. Similar to stratified drift, topographic contours were used to determine groundwater that flows into the circle.

Very little data is available for most of the smaller non-community wells, which account for approximately two-thirds of the public wells in Rhode Island. A circle with a radius of 1,750 feet, derived from a solution of the Theis equation, was used for the WHPA for all of the smaller non-community wells. Generalized input values based on published sources were used in the Theis equation resulting in the 1,750 foot radius.

Refined Delineations

Initial DEM WHPA delineations provide a basis for local protection efforts. Ideally, the delineations for the community wells and perhaps some of the non-transient non-community wells, particularly the larger wells, will be

Figure 3: Hypothetical Wellhead Protection Area Delineation for Well in Stratified Drift



revised in the future using more site-specific data and possibly employing more complex methods. No determination has been made regarding the responsibility and scheduling of what DEM is referring to as "refined" delineations. Once accepted by DEM, a refined WHPA delineation will replace the initial DEM WHPA in all groundwater programs.

At present, DEM has adopted refined delineation for 20 wells. These delineations address major public water supply wells in the Hunt Aquifer in North Kingstown, East Greenwich and Warwick; the town of North Kingstown's wells in the Annaquatucket Aquifer; and wells operated by local districts on Prudence Island and in Charlestown.

Over the next few years, refined delineations for several WHPAs will be completed with federal funds made available through the state's Source Water Assessment Program.

STEP 2

Pollution Source Inventory

Inventories of potential sources of groundwater pollution in WHPAs present clear pictures to local boards and suppliers of the threats that exist to their water supplies. Understanding the particular types of existing and potential contamination sources helps local governments and suppliers develop and implement more effective groundwater protection strategies.

WHPA inventories also provide DEM with an excellent means of geographically targeting compliance inspection activities. DEM reviews all inventories and has organized a multi-media inspection process with federal funding, which targets facilities identified by local entities as potential pollution threats in community and non-

Table 5: Step 2 Status—Pollution Source Inventories

Community (C) PWS Systems			
System Size (population)	Number of C PWS Systems Completed	Total Population Served Completed Systems	Number of C PWS Systems With Significant Partial Progress
Over 50,000	2	173,706	0
10,000-50,000	6	154,520	1
3,300-10,000	4	13,818	1
1,000-3,300	3	6,287	0
25-1,000	47	6,540	1
TOTAL	**62**	**354,871**	**3**

Non-Community (NC) PWS Systems		
	Number of NC PWS Systems Completed	Number of NC PWS Systems with Significant Partial Progress
Non-Transient Non-Community	64	12
Transient Non-Community	278	64
TOTAL	**342**	**76**

Municipal and Large Supplier				
	Number Completed	Number with Significant Partial Progress	Number with No Significant Progress	Total
Municipal	27	4	0	31
Large Supplier	11	4	0	15
TOTAL	**38**	**8**	**0**	**46**

transient non-community WHPAs. The inspection process has served to raise the facility owner's awareness about public wells located nearby, and it has identified practices on-site which may constitute a pollution threat or a potential violation of DEM regulations. See page 11 for more detail on the WHP Enforcement Initiative.

Under the WHP Program, each municipality with WHPAs is required to conduct a pollution source inventory. The 15 large suppliers are responsible for conducting the inventory within their own WHPAs.

DEM developed a guidance document in 1992 to assist the suppliers and municipalities in conducting the required inventories. The minimum procedure for conducting the WHPA inventories is:

- ☑ Designate person(s) who will be responsible for WHP activities for the town or water supplier;
- ☑ Using the WHPA delineations completed by DEM, transfer WHPAs onto town maps;
- ☑ Conduct a field survey of the WHPAs and identify on town maps those land uses or activities that represent a threat to groundwater;
- ☑ Complete data forms for each of the threats. This information includes owner name, address, location (plat and lot), whether or not the facility is sewered, and any relevant information which aids in assessing the facility's threat to groundwater.

Eighty-two percent of the required inventories have been completed – 27 out of 31 municipal and 11 out of 15 large supplier. A review of Table 5 shows that 95% of the community systems and 82% of the non-community systems have completed inventories.

Within this two-year reporting period only 3 additional inventories were submitted to DEM. During this period, the Rhode Island Department of Health developed the procedure for conducting inventories and assessments under the state's Source Water Assessment Program. The DOH inventories and assessments under the Source Water Assessment Program will provide a detailed update to the WHP inventories that were previously done and fulfill the inventory requirements where there was no prior inventory.

A Vulnerability Assessment of Public Supply Wells in Rhode Island

US Geological Survey Report in cooperation with RI Department of Health
Water Resources Investigation Report 99-4160
Leslie A. DeSimone and Lance J. Ostiguy

A vulnerability assessment was conducted for community wells and non-transient non-community wells in Rhode Island (256 in all as of December 1996). Water quality data from the DOH and available land use, hydrogeologic and other spatial data were used to identify factors that contribute to the relative vulnerability to contamination of public water supply wells. Vulnerability to contamination was investigated for 10 classes of contaminants. For each class of contaminant, threshold criterion were determined in order to characterize the well water as "affected" or "unaffected" based on the historical water quality data. Statistical tests were used to identify factors that were significantly different between affected and unaffected groups. These factors were considered indicators of a well's likelihood of being contaminated and thus potential contributors to a well's vulnerability to contamination.

Vulnerability factors were identified successfully for six contaminant classes: nutrients, pesticides, solvents and other industrial organic chemicals, road deicing chemicals, fluoride and radionuclides. Land use in the WHPA and aquifer type (stratified drift or bedrock) were the best indicators of potential contamination for nutrients, pesticides, solvents and road deicing chemicals. Residential land use and a type of urban land use that includes parks and golf courses were significant factors for nutrients. For pesticides, the most significant land uses were the urban land use that includes parks and golf courses and institutional land use. Industrial land use in the WHPA was a significant vulnerability factor for solvents, and urban land use was associated with wells affected by deicing chemicals. Wells screened in stratified drift aquifers were more likely than bedrock wells to be affected for all four of these contaminant classes. In contrast, fluoride concentrations and radionuclide activities were more likely to be elevated in bedrock wells.

Each of the 256 public wells in the study was designated as more or less vulnerable to contamination for each of the six contaminant classes. 139 wells (54%) were categorized as "most vulnerable" for at least one of the contaminant classes. The Report presents a procedure for determining an overall vulnerability ranking which identified 70 wells as most vulnerable to contamination, 159 wells as moderately vulnerable, and 27 wells as least vulnerable.

(Above text excerpted, with modifications, from the USGS Report)

STEP 3

Implementing Wellhead Protection

The **implementation** of wellhead protection strategies is the most important step in the overall WHP process. In Rhode Island, state government, water suppliers and municipalities all have vital roles in the implementation of groundwater protection measures.

How do we effectively measure protection? EPA recognizes that pollution source management/resource protection is an on-going dynamic process that is never complete. To say that a well is "protected" implies that the well will not be impacted by any source of contamination, which of course can never be said. It is more appropriate to look at the level of protection: low, moderate, high – always recognizing that protection efforts are never completed.

To be consistent with previous reporting efforts, DEM will use approved WHP Plans as the primary indicator of protection in Table 6. The term "completed" in Table 6 refers to a completed WHP Plan for the system, municipality or supplier, whichever is applicable. For this reporting period, EPA has allowed for the state to determine where "significant partial progress" has been made on protection. The EPA recognizes the efforts listed below by the state, local government, or by supplier as "significant":

Table 6: Step 3 Status—Implementing Wellhead Protection

Community (C) PWS Systems

System Size (population)	Number of C PWS Systems Completed	Total Population Served Completed Systems	Number of C PWS Systems With Significant Partial Progress
Over 50,000	1	63,706	1
10,000-50,000	4	73,344	3
3,300-10,000	4	41,500	1
1,000-3,300	1	3,056	2
25-1,000	24	10,634	24
TOTAL	**34**	**192,240**	**31**

Non-Community (NC) PWS Systems

	Number of NC PWS Systems Completed	Number of NC PWS Systems with Significant Partial Progress
Non-Transient Non-Community	14	62
Transient Non-Community	90	252
TOTAL	**104**	**314**

Municipal and Large Supplier

	Number Completed	Number with Significant Partial Progress	Number with No Significant Progress	Total
Municipal	5	21	0	26
Large Supplier	6	8	1	15
TOTAL	**11**	**29**	**1**	**41**

Note: Five municipalities that were required to complete WHP inventories have been granted exemptions from the requirement to prepare WHP Plans because of minimal dependence on public wells. The exemption is granted provided there are no community wells in the municipality and the local comprehensive plan addresses groundwater and specifies policies for its protection.

- Zoning ordinances/subdivision ordinances
- Site plan review
- Design/operating standards subject to inspection
- Introduction of Best Management Practices (BMPs), e.g., with respect to stormwater runoff, agricultural practices, salt storage, etc.
- Source prohibitions
- Purchase of property or development rights
- Public education and outreach

Table 6 summarizes WHP implementation efforts in the state. 52% of the community systems and 25% of the non-community systems are addressed by a WHP Plan. (In 1997, the percentage were 6% and 4%, respectively.) All water systems in the state are at least indicated as having significant partial progress on protection of their wells since the adoption of Rhode Island's Wellhead Protection Program. This determination is made based on the presence of the state's regulatory programs that have incorporated WHP, and the many municipal efforts that have taken place, not the least of which is the adoption of comprehensive plans that address groundwater protection.

State Protection Actions

Designating WHPAs as a Priority for Protection

The Wellhead Protection Program is one key component of the state's overall strategy to protect groundwater quality. Protection of WHPAs has been incorporated into the state classification system for groundwater that was mandated by the 1985 Rhode Island Groundwater Protection Act. The law provided for differential protection which recognized that certain aquifer areas are more valuable than others.

Under regulations promulgated by DEM in 1992, the state's most productive aquifers are designated GAA and are provided the highest degree of protection. All community WHPAs are also designated GAA. Non-community WHPAs are classified either GA or GAA depending on their hydrogeologic setting. The goal in both GA and GAA areas is to preserve groundwater quality in a manner consistent with its purpose of providing a clean drinking water supply.

Pollution Control Regulations

In Rhode Island, DEM is vested with the legal authority and responsibility for regulating wastes and controlling pollution. Past reviews of groundwater pollution trends revealed petroleum and volatile organic compounds to be the leading cause of the permanent closure of public wells. Several state laws, as well as DEM regulations, have been revised and strengthened over the last decade to improve the protection of groundwater resources, in particular for community wellhead protection areas. A variety of DEM regulations now include siting prohibitions to prevent the establishment of facilities which pose a significant pollution threat in WHPAs. For example, since 1992, no new underground storage tank facility has been allowed in community WHPAs. (97.4% of the active UST facilities statewide are in compliance with the requirement to replace or upgrade substandard tanks.) Most rules governing DEM regulated facilities also now include design requirements which are aimed at eliminating or minimizing the groundwater pollution threats associated with the facility's operations. A listing of selected specific protections provided by state pollution control rules is in Table 8.

Encouraging Regulatory Compliance in WHPAs

Within its jurisdiction at the state level, DEM has taken steps to insure that potentially polluting facilities in WHPAs are given high priority for inspection and enforcement action. Specifically, the Wellhead Protection Enforcement Initiative was instituted in October 1993 to provide a mechanism to coordinate the review of facilities in WHPAs for compliance with DEM regulations.

Supported with EPA Non-point Source funds, the project has allowed DEM to conduct multi-media inspections of facilities identified in the WHPA pollution source inventories and to more efficiently pursue both informal and formal enforcement actions to insure that facilities with potential violations are brought into compliance.

The project continued through this recent reporting period. A total of 355 facilities have been inspected within the WHPAs of 60 wells (mostly community wells). 138 potential regulatory violations were identified at 98 facilities. The potential violations were in such programs as underground storage tanks, underground injection control, RCRA and solid waste. Violations have been corrected at approximately 70% of the facilities, and DEM is continuing to pursue action to achieve compliance at the remaining facilities.

Table 8: Selected State Regulations Which Benefit Wellhead Protection Areas

Prohibitions:

- ✘ The establishment of new underground storage tank facilities in community wellhead protection areas is prohibited. (Existing facilities may replace their tanks.) Abandonment of any size tank is prohibited. (DEM)
- ✘ The establishment of new solid waste landfills and facilities for the disposal of hazardous waste in areas where groundwater is classified as GAA, which includes all community wellhead protection areas, is prohibited. (DEM)
- ✘ The underground injection of hazardous or radioactive wastes is prohibited. (DEM)
- ✘ Sludge is not allowed to be land applied or composted within 1,000 feet of any private well or within a wellhead protection area of any public well. (DEM)
- ✘ New septic system discharges may not be located within 100 feet of a private well or 400 feet of a public well. (Variances may be granted in cases of hardship.) (DEM)

Regulatory Requirements:

- ✓ New USTs, subject to DEM regulations must be double-walled. Leak detection on new motor fuel tanks must be continuous, e.g., 24-hour, interstitial monitoring. (DEM)
- ✓ Bare steel or metal as a construction material for new UST installations is prohibited in any location. Operation of single-wall USTs storing motor fuels or hazardous materials which are not protected against corrosion is prohibited beyond 12/21/98. (DEM)
- ✓ Spill containment is required for all above-ground tanks above 500 gallons. Tanks over 5,000 gallons located in areas where groundwater is classified as GAA must have in place a groundwater monitoring system. (DEM)
- ✓ No person shall release any hazardous material which may impact the classification or uses of groundwater. (DEM)
- ✓ The land within 400 feet of gravel packed wells and within 200 feet of bedrock wells must remain under the direct control of the water supplier by either ownership or recorded easement. The water supplier must maintain this area free from potential sources of contamination. (DOH)

Note: This list is not intended to be all inclusive.

Other Key Actions

The Rhode Island Water Resources Board administers a drinking water protection program for the large water suppliers funded by a $.01 per 100 gallon surcharge collected by the suppliers (see Appendix 1). Over the past few years, hundreds of acres of land have been purchased by groundwater dependent suppliers. For the two years covered by this biennial report, water suppliers have been in Phase II of this program—spending remaining funds from the first bond program on water quality improvement projects, which includes water treatment facilities, cleaning water mains, wellfield improvements (e.g., drainage, fencing), etc.

The Rhode Island Department of Health, in its role to ensure that drinking water provided by public water systems meets drinking water standards, has several program elements that relate to WHP. The DOH regulations require:

- Site plans for new wells to contain information on potential sources of contamination within 1,750 feet of the proposed well.
- Water supply facilities to periodically undergo sanitary surveys to evaluate the facility equipment, operation and maintenance and identify conditions that could result in unsafe drinking water.
- Source Water Assessment Program discussed on page 4.

Local Protection Actions

The success of the wellhead protection program depends on the development and implementation of effective strategies by local governments and large suppliers to protect groundwater quality in WHPAs. Options for local wellhead protection include public education, land acquisition, groundwater monitoring, changes in local zoning ordinances, as well as design and operating standards. Local governments and suppliers have maximum flexibility in preparing strategies to enhance wellhead protection and to determine the methods that are appropriate for their particular circumstances. However, groundwater education is one approach DEM has determined should be a major component of any WHP plan. The WHP plans and inventories are required to be updated at least once every five years.

In 1996, DEM prepared the "Guidance Document for Municipal and Water Supplier Wellhead Protection Plans." In addition to outlining the required elements of the Plan, the document discusses the more commonly applied protection strategies that can be used by a municipality or supplier, discusses the delineation of WHPAs, and includes an example groundwater protection overlay district ordinance. This document was provided to all of the municipalities and suppliers required to prepare WHP plans.

The local WHP plan must include:

- An evaluation of groundwater quality in the WHPA based on any available groundwater data and the potential contamination source inventory;
- A description of present and past efforts to protect groundwater quality, both regulatory and non-regulatory;
- Identification of the protection strategies determined by the local government and the supplier to be most appropriate for protecting groundwater quality within the WHPAs;
- Implementation approach for the protection strategies and a five year schedule of activities for implementation; and
- Efforts to coordinate implementation of the plan between municipal governments and water suppliers and between neighboring municipalities, where applicable.

It is important to note that lack of a protection plan does not preclude the implementation of protection strategies. Communities and water suppliers have long realized the need to protect groundwater that serves as their drinking water source, and many have taken major steps to protect this resource, with or without a protection plan. The existence of a plan does not necessarily equate to the implementation of effective protection strategies.

During this reporting period, DOH developed the state's Source Water Assessment Program. Under this Program, local committees will be established to assist DOH in conducting the inventories and assessments. It is anticipated that the subsequent distribution of the assessments to the public will spark interest in developing and implementing WHP activities. In addition, DEM and DOH will work to coordinate their efforts consistent with DEM's watershed protection approach.

DEM and DOH are concerned about providing a coordinated approach when dealing with the communities and the suppliers. Given that one of the purposes of the Source Water Assessment Program is to provide information for protection of public water systems, DEM and DOH have determined that it is better for DOH to work with a community on the source water assessment prior to DEM attempting to initiate development of protection efforts. DEM will be ready to assist with source water protection and WHP plan development following DOH source water assessment activities in a community. In the interim, DEM will work with local governments and local committees that express an interest in WHP implementation.

Municipal WHP Implementation

Many communities in the state have a significant dependence on private wells that supply residences and businesses, and others have surface waters that are used for drinking water in addition to the public wells. In these communities, DEM is strongly recommending that a drinking water protection plan for the town be developed that goes beyond addressing just the WHPAs. (The protection strategies for surface water are similar to those that would be implemented for groundwater.) Furthermore, it is important that the municipal WHP plan be consistent with the local comprehensive plan, and in many cases, it will serve to satisfy implementation steps identified in the comprehensive plan.

As part of the WHP Technical Assistance project, DEM worked with the town of West Greenwich to develop a protection plan that was approved by the town council in 1997. Because the entire town is dependent on

Public Education and Outreach

Although it is up to the municipality or supplier to determine which protection strategy is best suited to the particular situation, a WHP Plan must have an education component. DEM believes that public education and outreach are extremely important for protection of groundwater resources. The purpose of education and outreach is to increase awareness among the citizens and business owners of the value and importance of groundwater to them and the community, and to provide an understanding of the threats to groundwater quality and what can be done to prevent contamination. Several different approaches can be used for education and outreach:

-Brochures developed specifically for the community;

-Generic brochures on specific groundwater issues;

-Press releases or articles for the local newspaper;

-Meetings for residents with guest speakers on specific groundwater topics;

-Informational displays with maps and literature at prominent locations in the community such as the library or town hall;

-Incorporation of groundwater/water resource protection in school curriculums using one of several curriculum packages that have been developed;

-Informational seminars for the business community focusing on pollution prevention, BMPs, regulatory compliance, etc.;

-Road signs alerting the public to the location of WHPAs;

-Public service announcements on local radio stations.

groundwater for its drinking water, the plan is a townwide groundwater protection plan. The plan has been and will continue to be used as a template for similar rural towns developing their own protection plans.

DEM used $60,000 from an EPA grant in 1999 to fund implementation of municipal and supplier WHP activities. Five communities and 2 suppliers were chosen to receive the grants, which ranged from $4,500 to $11,250. The money was not available for use in preparing WHP Plans. Priority in awarding the grants was given to those municipalities and suppliers with an approved WHP Plan, but a WHP Plan was not necessary to qualify for an implementation grant. The projects funded under the grants include various public education efforts, WHPA road signs, teacher training program, UST removal, adoption of groundwater protection ordinance, and secondary containment for a back-up generator. Communities and suppliers chosen to receive the funds were: Block Island, Charlestown, East Greenwich, Kent County Water Authority, North Kingstown, Scituate Commons Housing Complex, and West Greenwich.

Funds from a superfund site settlement agreement and federal funds from the Clean Water Act are being used for the development and implementation of a WHP/drinking water protection plan in Cumberland. The Pawtucket Water Supply Board, whose water sources are in Cumberland, has been an active participant in this process.

WHP Plans have been developed in the towns of North Kingstown, West Greenwich, Tiverton, Charlestown, and South Kingstown. Public wells in these communities are indicated in Table 6 as being addressed by a WHP Plan.

WHP/groundwater protection must be evaluated separately in each community. Each community is unique, and what may be appropriate in one, may not be at all appropriate in another. The best example is the groundwater overlay protection district in a zoning ordinance. There are groundwater dependent communities in RI where a groundwater protection overlay district ordinance is not appropriate. In such a town, there may be only two or three small community WHPAs serving privately owned water systems (nursing home, mobile home park), all other residences are dependent on on-site wells, there is no major aquifer capable of significant water supply development. The difficulty in determining whether a particular strategy is effectively implemented for protection at the local level is evidenced by the situation in one town in RI that has a site plan review ordinance. The ordinance does not have specifics for groundwater protection, but it allows the community to require an impact analysis and to specify the scope and level of analysis required (which can and often does involve groundwater). The key to such an ordinance is in the routine implementation. In this instance the community is entirely dependent on groundwater, therefore there is a strong sense of awareness regarding the value of

and need to protect groundwater, even though groundwater issues/concerns may not be formally integrated.

The RI Comprehensive Planning and Land Use Regulation Act (Title 45, Chapter 22.2) requires each municipality to adopt a comprehensive plan and amend their zoning and subdivision regulations to be consistent with the plan. As a result, many zoning and subdivision regulations have been amended to include provisions for groundwater protection. Groundwater overlay ordinances have been developed or are in draft stage in many communities. (See discussion of Groundwater Protection in Southern Rhode Island.) The comprehensive plans often include other strategies for groundwater protection that are to be addressed, e.g., site plan review and public education. Each municipal comprehensive plan is reviewed by different offices within DEM, including the Office of Water Resources Groundwater Protection Program. It has been determined that all those municipalities with public wells have comprehensive plans that are consistent with the goals and policies of the state's Groundwater Protection Program.

Large Water Suppliers

The "Water Quality Protection Plans" that the large water suppliers must have approved by the RI Water Resource Board in order to spend money collected under the $.01 per 100 gallon surcharge program, are very similar to the WHP plan requirements:

1) Determine the boundaries of the reservoir watershed or aquifers serving public wells;

2) Identification of the sources of contamination for each reservoir or wellfield;

3) Identification of measures needed to protect each reservoir or wellfield from sources of contamination; and

4) A priority list of actions for implementing these protection measures.

The key elements are the same—delineate, inventory,

Groundwater Protection in Southern RI

The municipalities in mainland southern Rhode Island are entirely dependent on groundwater for all of their water supply needs. Within these towns is a network of major stratified drift aquifers that have been the focus of protection efforts. Major public water suppliers have wells in and provide water to residents in North Kingstown [1], South Kingstown, and Westerly. Residents in the towns of Charlestown, Exeter, Hopkinton, and Richmond depend primarily on private on-site wells for their water supply. Narragansett residents utilize groundwater supplied by public water systems from neighboring communities.

Recognizing the dependence on groundwater, the EPA designated two sole source aquifers in this area in 1988 -- the Pawcatuck Basin Aquifer System and the Hunt-Annaquatucket-Pettaquamscutt Aquifer System. In adoption of the state's groundwater classification system in 1992, DEM classified these aquifers and their recharge areas as GAA – the highest protection class. But more importantly, the communities in this part of the state have been very concerned about and very active in groundwater protection for many years as evidenced best by the adoption of WHP Plans in North Kingstown, Charlestown, and South Kingstown, distribution of public outreach and education materials in each of the seven communities, and the adoption of groundwater overlay district amendments to local zoning ordinances across the region.

Groundwater protection overlay district ordinances have been adopted by North Kingstown, South Kingstown, Exeter, Charlestown, Richmond and Westerly with a draft ordinance being discussed in Hopkinton. The groundwater protection zone adopted in these communities covers the major stratified drift aquifers using delineations from DEM's GAA groundwater classification and US Geological Survey publications. The protection zones include aquifers within which lie WHPAs for major public wells supplying millions of gallons per day, as well as other areas that are not currently being used for water supply purposes in Exeter, Charlestown and Richmond, but have significant water supply potential.

The result of these efforts is regional coordination from all three levels of government—federal, state and local—in protection of a resource that does not respect political boundaries.

[1] North Kingstown has been designated as a "Groundwater Guardian" community by The Groundwater Foundation – the only community so designated in the state.

develop a protection strategy. These plans have focused on land acquisition, as they would given the purpose for developing the plans. Since these plans have been approved by the state and since EPA is allowing for the state to document "significant progress" on each WHP element – public water systems with approved Water Resources Board "Water Quality Protection Plans" will be counted as having made significant progress unless they have an approved WHP Plan. Future updates of the Water Quality Protection Plans (required every 5 years) must be in compliance with the new "Rules and Procedures for Water Supply System Management Planning" (October 1998) adopted by the Water Resources Board. The Plan requirements therein have been made entirely consistent with the requirements of the WHP Program. Future plans approved under these regulations will then be considered having an approved WHP plan.

As of October 1999, 13 out of the 15 large suppliers have approved Water Quality Protection plans (Jamestown and the University of Rhode Island do not). The University of Rhode Island was just recently designated as a large water supplier by the 1998 rule changes. As of October 1999, 4 suppliers have approved WHP Plans. Two additional suppliers (Jamestown and North Kingstown) are part of the municipal government and their WHPAs are addressed in the approved municipal WHP plan. The result is that 6 of the 15 large water suppliers have approved WHP plans in place and 8 out of the remaining 9 have made significant progress on WHP implementation. (See Table 6.)

Small Water Systems

Although the small water suppliers in the state are not required to take action under the WHP Program, it is in their best interests to take steps to protect the water supply by working with the municipality and by applying WHP concepts to their own facility. The Atlantic States Rural Water Association receives grant funds to assist small water suppliers in protecting their source of supply. The Atlantic

Figure 4: Reproduction of Road Sign Prepared by DEM for the Town of South Kingstown's WHPA

States staff work with a system owner in bringing the system through the WHP process. The focus is on correcting and preventing pollution on their own property that may adversely affect their water supply.

To date, the Atlantic States Rural Water Association has assisted 16 community and 2 non-community groundwater based water systems in Rhode Island through the WHP steps culminating in specific protection activities. The primary implementation action has been the installation of signs alerting residents/visitors that they are in a water supply area and other means of public education. These systems have been counted as having an approved WHP Plan in Table 6.

Contingency Planning

The Rhode Island Wellhead Protection Program, approved by EPA in 1990, includes a Contingency Planning component as required by the 1986 amendments to the Safe Drinking Water. The WHP Program required contingency plans to be submitted by the large water suppliers in the state defined as those submitting Water Quality Protection Plans to the Rhode Island Water Resources Board. The contingency plan is used to create a state of awareness regarding the necessary responses in the event a well or wellfield becomes contaminated and to identify the steps necessary to ensure that the public is provided with a safe supply of drinking water.

As discussed in Appendix 1, the large water suppliers have been subject to water supply management planning requirements first of DEM and more recently the Rhode Island Water Resources Board. These plan requirements include an emergency planning component. Compliance with the emergency planning requirements of these plans, fulfills the obligations of the large water suppliers with respect to contingency planning under the WHP Program.

Contingency planning for all the other public water systems in the state is also important. Contamination, or the threat of contamination, will be handled by the existing network of state emergency management response mechanisms as administered by the Department of Health, the Emergency Management Agency, and the Department of Administration. Although these smaller systems are not specifically required to prepare contingency plans, they are encouraged to pursue emergency planning as part of the administration of their system.

Looking Ahead

Rhode Island continues to take important steps in the protection of the state's groundwater resources. DEM looks forward to continued involvement in the implementation of the Department of Health Source Water Assessment Program, which is expected to generate interest and concern for protection of WHPAs. DEM is planning on making another round of grants available to municipalities and suppliers for the implementation of WHP activities. Additional funds from the superfund site settlement agreement mentioned in an earlier section will be provided to Lincoln for WHP initiatives.

Long-term protection of the state's groundwater resources will require continued efforts on behalf of the state, local governments and water suppliers with success measured by our ability to sustain vital groundwater resources in a condition free of contamination.

Acknowledgements

This biennial report was prepared by the Rhode Island Department of Environmental Management Office of Water Resources. The Office of Water Resources wishes to acknowledge the continued efforts of the Department of Environmental Management Office of Waste Management and the Office of Compliance and Inspection in incorporating wellhead protection areas as priority areas in the implementation of their regulatory programs.

The cooperation and assistance provided by the Rhode Island Department of Health Office of Drinking Water Quality and the Rhode Island Water Resources Board in the preparation of this report and in the development and implementation of the Wellhead Protection Program over the years is greatly appreciated. A portion of the activities conducted under the WHP Program are supported with federal funds through section 106 and 319 of the Clean Water Act.

Appendices

Appendix 1

Large Water Supplier Planning Requirements

In 1987, the legislature enacted the Public Drinking Water Protection Act (RIGL 46-15.3-1.1) which created a water supply protection program for the large water suppliers in the state administered by the Water Resources Board. In accordance with the Act, a $.01 surcharge per 100 gallons of water sold is collected by the large water suppliers. This money is leveraged by the Water Resources Board to provide funding for land acquisition to protect water quality in watersheds and aquifers supplying drinking water and to support water quality improvement projects. In order to be eligible to receive funds from this program the suppliers had to have an approved "Water Quality Protection Plan." The Plan requirements were minimal and the protection activities were geared towards land acquisition, as would be expected since the plan's purpose was to ensure that the supplier had justification for its land acquisition goals.

In 1993, DEM adopted regulations incorporating the elements of the state's Wellhead Protection Program that was approved by EPA in 1990. The WHP plan required by the municipalities and water suppliers is similar to the Water Resources Board Water Quality Protection Plans, however more information was required in the WHP Plan on past efforts and future protection strategies. The suppliers are required to examine all possible groundwater protection activities that would be suitable for their unique situation, including but going far beyond land acquisition. It was agreed between DEM and the Water Resources Board that an approved WHP Plan would meet the requirements of the Water Quality Protection Plan.

In 1991, the Rhode Island legislature enacted the Water Supply Management Act (RIGL 46-15.4) which required DEM to develop regulations for the preparation of Water Supply Management Plans by those water suppliers that purvey more than 50,000,000 gallons of water per year. The resulting regulations required a pollution source inventory and management plan that was deferred to the WHP Program for the groundwater suppliers.

Although there was an attempt by the state offices involved to coordinate and emphasize that only one protection plan was necessary for all three requirements, there understandably was considerable confusion on the part of the suppliers in regards to plan requirements.

Improvements to this situation were initiated by the passage of the Public Drinking Water Protection Act of 1997 (RIGL 46-15.3) that transferred authority for overseeing the development and implementation of the water supply management planning to the Water Resources Board. The "Rules and Procedures for Water Supply System Management Planning" (October 1998) adopted by the Water Resources Board have a Water Quality Protection Component that requires the suppliers to address the same elements as in a WHP Plan. Given that the Plans require the same elements, DEM intends to amend the "Rules and Regulations for Groundwater Quality" that address WHP such that the large water suppliers will only have to submit **one** plan for the protection of their water supply. The Water Resource Board regulations specify an interagency plan review period in which DEM will have an opportunity to review the plans for consistency with the WHP Program.

Large Water Suppliers

System Name	Well Name or Number	Pump Rate for WHPA Delineation[1] (gallons per minute[2])	Date Installed (as provided by the watersupplier)	Acres in WHPA	Total WHPA Acreage for All Wells Within System
Bristol County Water Authority	#1A	486	1949		
	#2	417	1950		
	#3	417	1957	482[3]	482
Cumberland	Manville #1	457	1965		
	Manville #2	478	1977	37	
	Abbott Run #2	313	1983		
	Abbott Run #3	367	1984	40	77

System Name	Well Name or Number	Pump Rate for WHPA Delineation[1] (gallons per minute[2])	Date Installed (as provided by the watersupplier)	Acres in WHPA	Total WHPA Acreage for All Wells Within System
Harrisville	#2	200	1958	15	
	#3	200	1968	250	265
Jamestown[4]	#1	—	1995		
	#3	—	1996	342 [3]	342
Kent County Water Authority	Spring Lake	700	1960	413	
	Mishnock #1	911	1965		
	Mishnock #2	1,587	1966	302[3]	
	KC-Warwick #1	697	1965	954[5]	1,669
Kingston Water District[6]	#1	360	1965		
	#2	500	1982	331[3]	
	#3	—	1997	287	618
Lincoln Water Commission[7]	Manville #3	694	1964		
	Manville #5	694	1970		
	Manville #10	694	1979	59[3]	
	Lonsdale #4	694	1964		
	Lonsdale #11	694	1981	489[3]	548
North Kingstown	#1	688	1942		
	#2	550	1956		
	#4	646	1967		
	#5	739	1969	2,236[3]	
	#6	1,000	1978	316	
	#3	1,000	1961		
	#7	250	1980		
	#8	250	1980	149[3]	
	#9	1,252	1941		
	#10	1,200	1943	954[5]	
	proposed well	700	—	246	3,901

System Name	Well Name or Number	Pump Rate for WHPA Delineation[1] (gallons per minute[2])	Date Installed (as provided by the watersupplier)	Acres in WHPA	Total WHPA Acreage for All Wells Within System
Pascoag Fire District	#2	150	1947		
	#3	450	1970	158[3]	158
Pawtucket Water Supply Board	#2	600	1969		
	#3	818	1950		
	#4	1,200	1958		
	#5	700	1958		
	#6	700	1966		
	#7	743	1966		
	#8	652	1966		
	#9	703	1966	730[3]	
	#10	500	1967		
	#11	300	1968	1,027[3]	1,757
RI Economic Development Corporation	#3	1,400	1964		
	#9A	400	1942		
	#14A	950	1942	954[5]	954
South Kingstown	South Shore #1	556	1979		
	South Shore #2	417	1976	951[3]	951
United Water Company	#1	300	1942		
	#2	490	1942		
	#3	110	1949		
	#4	750	1958		
	#5	900	1966		
	#6	1,290	1971	1,907[3]	1,907
University of Rhode Island	#2	500	1949		
	#3	800	1958		
	#4	1000	1974	325[3]	325

System Name	Well Name or Number	Pump Rate for WHPA Delineation[1] (gallons per minute[2])	Date Installed (as provided by the watersupplier)	Acres in WHPA	Total WHPA Acreage for All Wells Within System
Westerly	#1A	500	1972		
	#1B	500	1973		
	#1C	500	1973		
	#2A	750	1984		
	#2B	750	1984		
	#2C	750	1984		
	#3	750	1964	1,111[3]	
	Bradford #2	500	1981		
	Bradford #3	750	1983	690[3]	
	Crandall	750	1986	1,933	
	Noyes Avenue	750	1982	247	3,981

1 Source: DEM wellhead delineation database. Data may not reflect actual use or peak capacity.
2 700 gallons per minute is equivalent to approximately one million gallons per day.
3 This data is a combined figure for grouped wells that are in such close proximity to each other that their WHPAs overlap.
4 These are bedrock wells for which an interim WHPA has been delineated.
5 These acreage figures include the entire area within the Hunt Aquifer WHPA along the Hunt River from approximately Route 4 east to Route 1.
6 Well #3 is not yet operational. It will likely have a pump rate of approximately 700 gpm. An interim WHPA has been delineated.
7 Lincoln Water Commission wells are on standby status. Currently, Lincoln purchases all of its water from the Providence Water Supply Board.

Appendix 2: Municipal Wellhead Protection Area Information[1]

Town Name	Town Acres	Total WHPA Acres	% of Town Lands in a WHPA	Total Com. WHPA Acres	% of Town Lands in a Com. WHPA	Wells: Com.	Wells : Non-Transient Non- Com.	Wells: Transient Non-Com.	Wells: Total
BARRINGTON	5500	482	8.8	482	8.8	3	0	0	3
BURRILLVILLE	36456	5371	14.7	1559	4.3	13	7	27	47
CHARLESTOWN	24439	9249	37.8	3493	14.3	14	8	65	87
COVENTRY	39972	3987	10.0	1545	3.9	8	5	15	28
CRANSTON	18505	1078	5.8	330	1.8	5	4	3	12
CUMBERLAND	18078	2371	13.1	1575	8.7	14	0	5	19
EAST GREENWICH	10438	1030	9.9	880	8.4	3	1	1	5
EXETER	37371	4535	12.1	1258	3.4	6	6	15	27
FOSTER	33261	4860	14.6	1271	3.8	4	2	27	33
GLOCESTER	36373	9193	25.3	2020	5.6	10	10	53	73
HOPKINTON	28250	5874	20.8	1754	6.2	6	12	20	38
JAMESTOWN	6187	342	5.5	342	5.5	2	0	0	2
JOHNSTON [3]	15573	806	5.2	0	0.0	0	2	2	4
LINCOLN	12141	1405	11.6	595	4.9	5	1	4	10
LITTLE COMPTON	14458	2466	17.1	0	0.0	0	1	16	17
MIDDLETOWN	8447	1152	13.6	308	3.7	2	1	5	8
NARRAGANSETT [3]	9113	275	3.0	0	0.0	0	0	2	2
NEW SHOREHAM	6378	2249	35.3	964	15.1	3	0	30	33
NORTH KINGSTOWN	28268	4602	16.3	3052	10.8	9	2	13	24
NORTH PROVIDENCE [3]	3708	110	3.0	0	0.0	0	0	0	0
NORTH SMITHFIELD	15927	5617	35.3	1530	9.6	10	9	25	44
PORTSMOUTH	15103	1093	7.2	892	5.9	5	0	3	8
RICHMOND	26074	4995	19.2	2387	9.2	5	7	13	25
SCITUATE	35077	3057	8.7	648	1.8	2	10	11	23
SMITHFIELD	17669	1850	10.5	534	3.0	2	1	6	9
SOUTH KINGSTOWN	38823	6113	15.7	4210	10.8	16	1	17	34
TIVERTON	19421	1976	10.2	1033	5.3	4	2	7	13
WARREN	4000	55	1.4	55	1.4	2	0	0	2
WARWICK	22971	370	1.6	150	0.7	2	2	1	5
WEST GREENWICH	32779	2858	8.7	778	2.4	2	6	15	23
WEST WARWICK [3]	5178	305	5.9	0	0.0	0	0	1	1
WESTERLY	19398	3763	19.4	3353	17.3	11	0	1	12
WOONSOCKET [3]	5048	181	3.6	20	0.4	0	0	0	0
IN STATE TOTALS		93660		37018		168	100	403	671
OUT OF STATE TOTALS		1912		1275					

[1] Town acreage and WHPA figures have been rounded to the nearest whole number. All percentages have been rounded to the nearest tenth of a percent.

[2] The following towns have no wellhead protection areas: Bristol, Central Falls, East Providence, Newport, Pawtucket, Providence.

[3] These towns have been granted an exemption from the requirement to prepare a WHP Plan.